Entanglement area law from specific heat capacity

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http://journals.aps.org/prb/abstract/10.1103/PhysRevB.92.115134 [2]

We study the scaling of entanglement in low-energy states of quantum many-body models on lattices of arbitrary dimensions. We allow for unbounded Hamiltonians such that systems with bosonic degrees of freedom are included. We show that, if at low enough temperatures the specific heat capacity of the model decays exponentially with inverse temperature, the entanglement in every low-energy state satisfies an area law (with a logarithmic correction). This behavior of the heat capacity is typically observed in gapped systems. Assuming merely that the low-temperature specific heat decays polynomially with temperature, we find a subvolume scaling of entanglement. Our results give experimentally verifiable conditions for area laws, show that they are a generic property of low-energy states of matter, and constitute proof of an area law for unbounded Hamiltonians beyond those that are integrable.

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